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## EVOLVING SERIAL COMPARISON SYSTEM WITH CRITICAL ALERT NOTIFICATIONS

### CROSS-REFERENCE TO RELATED APPLICATIONS

This application incorporates by reference and claims the benefit of priority to U.S. Provisional Patent Application No. 61/903,706 filed Nov. 13, 2013.

### BACKGROUND OF THE INVENTION

The present subject matter relates generally to an evolving serial comparison system with critical alert notifications. More specifically, the present invention relates to a serial comparison system where the user may input free-form natural language text corrections that are recognized by the serial comparison system to generate diagnostic codes of a structured data format.

An electrocardiogram (ECG) is a noninvasive procedure used to measure the rate and regularity of heartbeats by measuring the electrical activity of the heart over a period of time using electrodes attached to the surface of the skin.

ECGs are the most efficient and effective tool for diagnosing cardiac arrhythmia, myocardial ischemia/infarct (heart attack), among other conditions, and are also useful for measuring the size and position of the heart chambers, the presence of any damage to the heart, and the effects of drugs or devices used to regulate the heart, such as a pacemaker.

An ECG produces a pattern reflecting the electrical activity of the heart and usually requires a trained clinician to interpret it. ECG waveforms often present biological variations, and, thus, the diagnostic value of a single ECG is limited. Comparing a current ECG to previous ECGs of a patient may reduce the limitations of a single ECG. This process is known as visual serial comparison. By examining ECG serial changes over time using visual serial comparison, physicians may make more accurate diagnosis.

Increasingly, computer interpretations of ECG readings are being provided to improve the speed of analysis and action. Commercial systems are available that provide valuable assistance in automated serial ECG comparison analysis. However, about 25-30% of these computer ECG interpretations are wrong. Incorrect ECG interpretations may cause serious medical problems to be overlooked, and may cause further errors in future automated ECG interpretations based on the erroneous ECG interpretation. Thus, review of automated ECG comparisons by physicians remains an important part of the diagnostic process.

Previous systems for the review of automated ECG interpretations required the correction of ECG interpretations using controlled data entry of codes and exact phrases prescribed by the serial comparison algorithms. By requiring entry of codes and exact phrases, previous review systems placed a burden on cardiologists to learn proprietary codes and phrases, or required the additional review step of having a technician to read a written correction of an ECG interpretation and translate the correction into the codes or phrases.

Additionally, automated review and confirmation of ECG readings is often performed not by the treating physician at the place and time of ECG recording but by a reading cardiologist or other trained professionals at later times. Accordingly, if a critical result is found it is important that the result be communicated to the patient's treating physician in a timely manner. Increasingly, providing critical results must be performed in a prescribed manner and logged to meet the

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standard of care. Accordingly, there is a need for automated reporting and logging of critical results.

Accordingly, there is a need for systems and methods for fast, efficient, easy-to-use review of automated ECG serial comparison interpretations including proper handling of critical alerts, as described herein.

### BRIEF SUMMARY OF THE INVENTION

To meet the needs described above and others, the present disclosure provides an evolving serial comparison system with critical alert notifications. A physician user of the serial comparison system may view clinical reports of patient ECG recordings including, e.g., waveforms and automatic interpretations, review and update the automatic interpretations, input diagnostic codes, trigger critical alerts, etc. When updating an automatic interpretation, the user may enter the updates in a free form text box using written English phrases and abbreviations comfortable to the user. The serial comparison system may translate the written English phrases and abbreviations into a structured data format of diagnostic codes, which may then be utilized in future serial comparisons.

The evolving serial comparison system may be provided as a server that users may access over a network. Users may communicate with the serial comparison system using a user interface. The user interface may be a web interface, a native application running on a user machine, a mobile application running on a mobile device, a dedicated device, or any other interface as will be appreciated by those of skill in the art from the examples provided herein.

The serial comparison system may be incorporated into the workflow or environment of a medical practice or hospital. Accordingly, the serial comparison system may interface with various physiological recording and testing devices to receive patient data, access remote servers, such as hospital health information systems storing patient data, and communicate with user devices.

Although described herein as working with electrocardiogram recordings, it is contemplated that the serial comparison system may operate on other physiological data, such as data collected from stress tests, Holter monitoring, defibrillators, pulmonary function testing, event monitoring, pacemaker, mobile telemetry, vital signs, EEG, blood pressure data, sleep monitoring, etc.

Serial comparison begins when a medical device, such as a cardiograph, generates a clinical report that may include physiological data and test results, e.g., cardiogram waveform and measurements. The clinical report may include interpretive statements from an algorithm run on the waveform and measurements by the medical device. In an embodiment, interpretive statements are a diagnostic classification of the state and behavior of the heart as determined from a cardiogram waveform. The serial comparison system may receive the clinical report via a direction connection, WiFi, LAN, the Internet or other network, via the network interface.

Upon receiving the clinical report, the serial comparison system may access a patient file and retrieve a previous clinical report for the patient. The previous clinical report may include a previous waveform and a previous physician edited interpretive statements. The serial comparison system may include a patient data database to access the patient file. Alternatively, the serial comparison system may communicate with a hospital patient records management system to access the patient file. The serial comparison system may store the new clinical report in the patient file.